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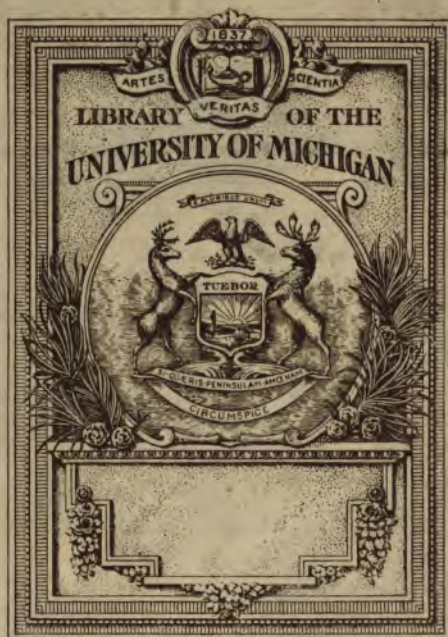
VOL. VI. No. 3.

THE MAPPING OF MISSOURI.

BY

ARTHUR WINSLOW,  
Assisted by C. F. Marbut.

*Issued September 23, 1892.*



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Prof. I. C. Russell

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# THE MAPPING OF MISSOURI.

BY ARTHUR WINSLOW,  
ASSISTED BY C. F. MARBUT.

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If the use of so trite an analogy is permissible, it is safe to say that, at this period of the world's history, the civilization of a people is closely proportional to the degree to which the country in which they live is accurately mapped. During periods of barbaric habitation, or during early settlement by more civilized foreigners only the rudest diagrams, if any, are made; such are sufficient to satisfy the simple needs of the

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time. As civilization grows or as the civilized population increases, wider knowledge of the geography and better maps become necessary to meet the needs of new settlement or of commerce; and, when population becomes dense, better and better maps are constantly demanded to answer the requirements of a great traffic, for purposes of construction and improvement and for the exact establishment of property lines which the enhanced value of real estate calls for. Hence, the mapping of an area is necessarily a progressive work; there is an evolution of cartography as of other objects, natural and cultural. The earliest charts are the products of exploration; rude sketches showing mere outlines and these defined with only a slight approach to accuracy. A few astronomically determined points, roughly determined at that, constitute the principal data as to location, supplemented, perhaps, by a meander line run down some river, in a boat, with hand compass bearings and estimated distances. As other explorations are made additional points are determined, lines of travel are meandered out, corrections are made of errors in former locations and, by degrees, a fairly reliable diagram of the area is produced. As the country becomes populated, surveys for political divisions and for cadastral divisions are inaugurated and, from these, additional facts are collected. Finally, and it is deplorable that it should seemingly be necessarily at so late a stage, triangulation is extended over the area, topographic mapping is prosecuted and detailed maps of various kinds to suit the different needs are produced. In nearly all civilized countries detailed and accurate maps are now constructed of different portions, but it would be hazardous to assert, at present, that of any one area the final map has been produced.

Missouri has had, like other countries, her succession of explorations and surveys and resultant maps, but she is still far from having reached the final stage. It is the purpose of this article to display the status of such work at the present time, to briefly sketch the history of mapping as affecting Missouri and to indicate the probable lines of future growth.

The first maps including the area of Missouri are necessarily those rough diagrams of the early explorers which repre-

sented the continent of America. Their relations to Missouri cartography are, of course, only of a general nature; but it is thought that they are of sufficient historic interest to justify a description of some of the more important ones here.

Rough attempts at the mapping of America began almost with its discovery and we find the general outlines of the continent suggested in charts dating back as far as the beginning of the 16th century.

*The map accompanying the edition of Ptolomæus of 1508*, edited in Rome, is credited with being the most complete and reliable extant of what was then known in regard to America.\* The title of the map translated is, "A more universal table of the known world compiled from modern observations." It contains, of North America, little more than a rough and generalized outline of the eastern coast as far south as Florida.

Columbus had entered the Gulf of Mexico but only explored its southern coast. The "Admiral's map" in the Ptolemy, edition of 1513, shows a delta of a river corresponding in position to that of the Mississippi; but this must have been from conjecture, as it was not until 1518 that the northern coast was completely explored by Garay, who reached the Mississippi river and gave to that stream the name *Rio del Espiritu Santo* (River of the Holy Ghost).†

*A Globe in Frankfort on the Main*, in the city library, is credited to the year 1515 or 1520, and is supposed to have been made by J. Schœner, whose globe of the latter year preserved in Nuremburg agrees with this in all its principal features.‡ This map represents the North American continent

\* A reduced copy of this map is contained in Vol. I opposite p. 499 of Lieut. Wheeler's Reports of the United States Geographical Surveys West of 100th Meridian.

† French's Historical Collections of Louisiana, Vol. IV, p. VII.

Winsor, in Vol. II of his Narrative and Critical History of America, on p. 218, gives a sketch of a map of the date 1520, which he states was sent to Spain by Garay, the Governor of Jamacia. It shows what seems to be the mouth of the Mississippi under the name "Rio del Espiritu Santo." Winsor characterizes it as a "surprisingly accurate draft of the shores of the Gulf."

‡ A reduced copy of a part of this map is contained in Vol. I, of the Reports of the U. S. Geog. Surveys west of 100th Merid., opposite p. 501.



by Bolognino Zaltieri. A printed copy is preserved in the imperial library in Paris. A sketch of a portion of a reduced copy of this map contained in Vol. I, of the 100th Merid. reports opposite p. 504, is presented here.

The name Gulf of Mexico, it will be noted is applied here, as is also the name Florida to the peninsular which now bears that name. Two large streams also enter the Gulf from the north, one of which may have been intended to represent the Mississippi, perhaps inserted from the results of the De Soto expedition earlier in the century. The mountain ranges indicated it is hard to find a place for in our modern topographic maps of the country. The approximate site of Missouri is added to this map for the purpose of the present article.



FIG. 2. MERCATOR MAP — 1569.

The Mercator (Girard) "mappemonde" of 1569, introduced his well-known projection. An enlarged copy of an outline sketch of a portion of this map relating to North America, is introduced above. It will be noticed that the Gulf of Mexico is represented much more accurately than in the earlier map of Zaltieri. The extension of the St. Lawrence river into the southwestern portion of the continent is a noticeable feature which we find reproduced in others which

succeed it. The existence of any great stream flowing into the Gulf, such as the Mississippi, is not even suggested.

*The Ortelius map* was first issued in 1570, in Antwerp. This resembles the Mercator map in the essentials, and a similar projection is used.\*

*The Hondius (Jodocus) map* of 1609 was also based largely upon the Mercator map. Hondius was a celebrated Dutch geographer who was associated with Mercator. The whole western hemisphere is represented upon his map and the Gulf of Mexico is fairly well outlined. The St. Lawrence is extended far into the interior. Some other details of interior drainage and distribution of mountains are also given.†

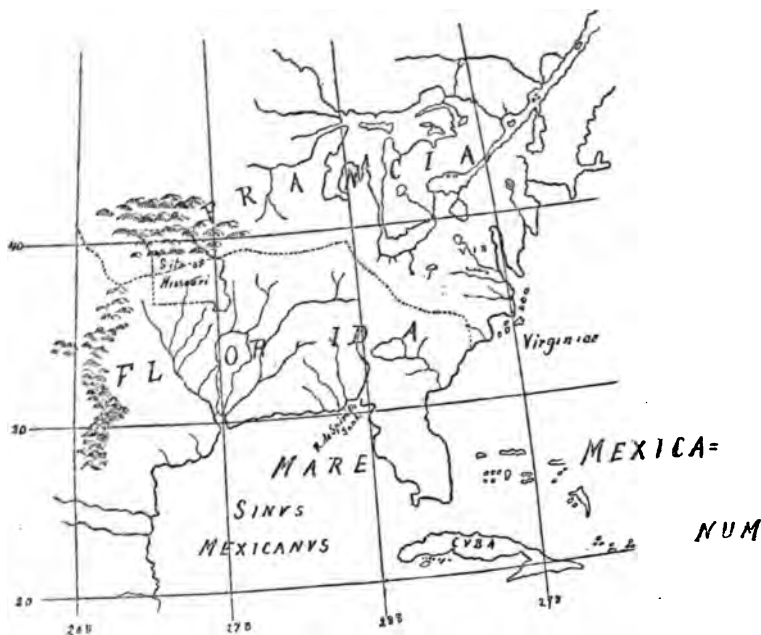


FIG. 3. DE WIT MAP — 1670.  
Initial Merid., presumably at Ferro Island.

*The De Wit map*, prepared about the year 1670, shows the

\* For a sketch of this map see Nar. and Crit. Hist. Vol. IV, p. 95 and for further references see Reports U. S. Geog. Surveys West 100th Merid. Vol. I, p. 508.

† 100th Merid. Reports, Vol. I, p. 506.

whole northern half of the continent. A sketch of a portion is presented here. The Gulf is quite accurately shown. The St. Lawrence is no longer extended so far inland. The presence of the Mississippi would seem to be suggested by the estuary-like mouth of an arborescent drainage system, but its mouth is actually located under the name *R. de Spiritu Santo*, near the northwestern corner of the peninsula of Florida.

In 1672-73 an anonymous map appeared representing the course of the Mississippi from the Lakes to the Gulf.\* It is, however, considered spurious; it was probably prepared by the Jesuits and was in advance of the appearance of the results of Joliet's and Marquette's exploration.†

The Joliet map of 1673-74 seems, says Winsor, to have been made by Joliet immediately after his return to Montreal from his expedition down the Mississippi in the summer of 1673 with Marquette. A copy of a sketch of this map is reproduced on the next page. This is considered the earliest map of the Mississippi based on actual knowledge. The exploration did not extend below the mouth of the Arkansas; but, from the course of the river at that point, and from information derived from the Indians, the explorers reached the conviction that the great river emptied into the Gulf and so represented it on their map. Joliet applied the name Buade (the family name of the Governor Frontinac, to whom the map is addressed) to the Mississippi.‡ This is also the first map

\* This is the map familiarly known as the Thevenot map, published in M. Thevenot's "Recueil de Voyages," in 1681. (A copy of this map is in library of the Mo. Hist. Society in St. Louis.)

† Nar. and Crit. Hist. Vol. IV., p. 220.

‡ Winsor further states in a foot note, on page 209 of Vol. IV, of his Nar. and Crit. Hist., that the Jesuit *Relations* call it the "*Grande Rivière*" and the "*Messi-sipi*," Marquette calls it "*Conception*" and in 1674 it was called after Colbert. On p. 79 of Vol. V, he states further that the original spelling of the word Mississippi in its nearest approach to the Algonquin word is *Mèchè Sèbè*; Tonty suggested *Miche Sepe*; Laval *Michisepe*; Labatt softened this to *Misisipi*; Marquette made it *Missisipi*; another explorer made it *Mississipi*, and it is so spelled in France at the present. The origin of the double p is not known. The river was known as the "*Malbanchia*" by the Indians and was termed "*Palissado*" by the Spaniards (*Ibid.* Vol. V, p. 18). In 1712 the name "*St. Louis*" is substituted for Mississippi in the Crozat patent and in the same document "*St. Philip*" is substituted for Missouri and "*St. Jerome*" for Ouabache (*Ibid.* Vol. V, p. 28).





FIG. 5. FRANQUELIN'S "GREAT MAP" — 1684.

It was prepared by a young French engineer, Jean-Baptiste Louis-Franquelin, who was in Quebec in 1683, on La Salle's arrival en route for France. A copy of a sketch is introduced here from Winsor.\* The name "*La Louisiane*," which was given the country by La Salle, on his reaching the mouth of the Mississippi, is applied here, as is also the name "*Mississippi*." The peculiar deflection of the lower course of the river and the position assigned its mouth are features difficult to understand, especially in view of the fact that the earlier Joliet map is much more true to nature in this respect. It suggests a reason for the unfortunate mistake which La Salle made, some two years later, in trying to find the mouth of the river with his colonists from France. A mistake which proved fatal to him as well as to many of his companions.† Another map of Franquelin, referred to as his "*third map*," is dated 1688. It contains some additional features of drainage which are shown in the accompanying sketch.



FIG. 6. FRANQUELIN'S "THIRD MAP" - 1688.

"*Missourils*," it will be noticed, is introduced here, from which the name "*Missouri*" is derived.‡ The interlacing

\* Nar. and Crit. Hist., Vol. IV, p. 228.

† The latitude of the mouth of the river was determined by La Salle by an observation in 1682, but he had then no means of determining the longitude.

‡ The Missouri river was called by Marquette "*Pekitanouis*," which means Muddy Water. In Shea's "*Discovery of the Miss. Valley*," is a foot note to the effect that the name *Pekitanoui* prevailed until 1712, when it was called Missouri after the *Missouris* tribe of Indians.

drainage system of the river is remarkable and indicates very imperfect knowledge of the region, and peculiar conceptions concerning it. The existence of the Osage river is suggested by the first fork above the mouth of the Missouri.

*Hennepin's map of 1683*, in his "*Description De La Louisiane*" contains nothing additional concerning the Mississippi or the area of Missouri. The connection of the Mississippi with the Gulf is here only indicated by a dotted line, in evidence that his explorations did not extend to the Gulf.\*

Later maps of Hennepin appeared in his work entitled "*Nouvelle Découverte d'un très grand Pays*" which show an extension of the Mississippi to the Gulf; but this portion is supposed to have been stolen from the records of La Salle's expedition.

*Minet's map of 1685*, entitled "*Carte de La Louisiane*" was made by the engineer, Minet, on the return voyage of the ship *Joly*, after leaving La Salle and his colonists at Matagorda bay.† The details of the mouth of the Mississippi as found by La Salle in 1682 and those of Matagorda bay were specially drawn. The river is shown to empty into the Gulf at Matagorda bay, which was mistaken by the expedition for its mouth. The course of the stream above the mouth is similar to that shown on the Franquelin map of 1684. The name *Missouris* is applied here also to that river, and it is represented by a peculiar double channel as in the Franquelin map.

In the year 1699 the expedition under Le Moyne d'Iberville reached the mouth of the Mississippi, established a settlement there and explored the stream for a distance of 100 leagues above its mouth. From that date on the river was traveled frequently by explorers and travelers and its course became well known.

*La Hontan's maps* originally appeared in 1703 in his "*Nouveaux Voyages dans l'Amérique septentrionale*,"‡ etc.

\* For a fac-simile of a portion of this map see Winsor's *Nar. and Crit. Hist.*, Vol. IV, p. 249.

† For a sketch of this map see Winsor's *Nar. and Crit. Hist.*, Vol., IV, p. 237.

‡ Portions of these maps are reproduced in *Nar. and Crit. Hist.*, Vol. IV, pp. 358 to 361.

On one of these, which is a strikingly crude production, the Ouabach, or Ohio river, is shown to empty into the Mississippi, opposite the mouth of the Missouri. This map is noteworthy as being the first one, to the writer's knowledge, on which the name Osage is applied to a tributary of the Missouri river. It is the one on which La Hontan shows his mythical "*Riviere Longue*," or "Dead River," which he claims to have explored. The lines of latitude and longitude are designated on the map, the latter being presumably east from Ferro island, as that point had been generally accepted by European mathematicians as the position of the initial meridian as much as seventy years previous. According to these lines the Mississippi river is as much as 100 miles west of its true position, and the mouth of the Missouri about 180 miles too far south.

*The Delisle maps (1703 and 1707)* are joint productions of the father and son, Claude and Guillaume Delisle.

Winsor speaks of them as the most distinguished French cartographers of the early part of the eighteenth century. Their map of the upper part of the Mississippi valley, under the title of "*Carte du Canada ou de la Nouvelle France*," \* shows the Missouri river and the location of the old Fort St. Louis. The Des Moines river is shown under the name R. de Moingona. In their map of the lower part,† the Ozark mountains are faintly suggested and are labeled "*Pays plein de Mines*;" this we find reproduced in several subsequent maps and it is perhaps based upon Penicault's report of the existence of lead mines west of St. Genevieve, which information he acquired when accompanying Le Sueur's expedition up the Mississippi in the year 1700.

*Sinex's (John) Map of North America* was published in London in 1710. A sketch of a portion is presented on p. 69. The course of the Mississippi is much more accurately shown than on any of the previously presented maps, as is also the lower course of the Missouri. The initial point for the

\* This map is reproduced in Winchell's Vol. I, p. 20, Final Report Geol. Survey of Minn.

† A reproduction of this portion of the map is contained in Winsor's Nar. and Crit. Hist, Vol. II, p. 294.

meridian lines is presumably Greenwich. On this assumption the outlines of the State are added to the sketch in fine dotted lines, while the outlines of the State with reference to topographic features are shown by the dash and dot lines.\*



FIG. 7. SINEX'S MAP - 1710.  
Initial Merid., presumably at Greenwich.

The Mississippi is thus shown to be located from 50 to 60 miles too far west and the mouth of the Missouri 25 miles too far north.

*Edward Wells'* atlas appeared in 1722, and consisted of 41 maps, of which one is a part of North America. A reduced copy of this is contained in Vol. I of the Reports of the 100th Merid. Surveys, opposite p. 511. The longitude of St. Louis is here at about  $113\frac{3}{4}^{\circ}$  W. and the latitude at about  $36\frac{1}{2}^{\circ}$  N. If the longitudes are referred to Greenwich, which is probable, the Mississippi is assigned a position over 20 degrees west of the true one, a much greater inaccuracy than in the earlier Sinex map. The course of the Mississippi

\* A reduced copy of this map is in Vol. I, opposite p. 510 of Reports U. S. Geog. Surveys west of 100th Merid., and the annexed sketch is from this.

river is also very crudely shown. The presence of the Ozark mountains seems to be suggested, but the range is continued eastward on the original map and south of the Illinois lake it is termed the "Apalachin M."

In 1733 an edition of a map by Henry Popple was issued, entitled "A Map of the British Empire in America, with the French and Spanish settlements adjacent thereto." \* It is in atlas form, the maps being in large colored sheets on a scale of about 50 miles to the inch. The Mississippi and Missouri rivers and their tributaries are shown, but very inaccurately.

D'Anville's map of 1752, entitled "*Carte de la Louisiane*," has only the lower Mississippi valley represented.†

Dumont's map of 1753, also named "*Carte de la Louisiane*," was published in Dumont de Montigny's "*Memoires historiques de la Louisiane*." It represents the Mississippi valley and adjacent country; lines of latitude and longitude are fixed on the map and, according to these, the longitude of the site of St. Louis is 284° E. (presumably of Ferro), which is about 94° W. of Greenwich.‡

The Du Pratz map of 1763 appears in the "History of Louisiana, by M. Le Page Du Pratz." The Mississippi river is placed about 150 miles west of the true position and the mouth of the Missouri about 70 miles too far north. On p. 295 of Vol. I, the author remarks that the French had penetrated only about "300 leagues" up the Missouri at that time.

In the year 1770, there was published in London, a work entitled "The Present State of the European Settlements on the Mississippi, with a Geographical Description of that River; illustrated by 8 plans and draughts: 4 to. By Capt. Philip Pittman." Of these draughts one entitled "Draughts of the Mississippi river from Balise to Fort Chartres," in three sheets, is of special interest here. His maps were the outcome of five years of surveys, and, from the published references,

\* A copy of this map is the property of Capt. Carl F. Palfrey, Secretary of the Mississippi River Commission, of St. Louis.

† A copy of this map is in the library of the Mo. Hist. Soc., St. Louis.

‡ A copy of this map is also contained in the library of the Mo. Hist. Society.

they must be far in advance of anything preceding in their representation of the river. The writer was unable to find the volume in the accessible libraries, and, hence, is unable to present a sketch of the map here.\*

*In the year 1765*, Lieut. Ross of the British army made a survey of the lower Mississippi river, and, in 1775, his map was published on a scale of about 14 miles to the inch, under the title of "A Map of the Mississippi River, from Balise to Fort Chartres. Taken on an expedition to the Illinois in 1765, by Lieut. Ross of the Thirty-fourth Regiment. Published 1775, London, for Robt. Sayres." The sketch on the next page is from a copy of this map in the Mo. Hist. Soc. library. This is a very interesting map and exhibits a great advance in the cartography of the river. The main sinuosities of the river are quite true to nature and are in accord with maps of recent date.† The latitude of the mouth of the Ohio river is shown to be a few minutes less than 37 degrees, which is closely in accord with recent determinations, which make it exactly 37 degrees. The longitude of New Orleans, shown on the map, is, however, about 50 miles east of what it should be. The note, west of the river, of, "A country abounding in mines," suggests a translation of the "*Pays plein de Mines*" on the Delisle map of 1707.

*Faden's Atlas of 1777*, is entitled "The North American Atlas. Printed for William Faden, Geographer to the King, MDCCLXXVII." ‡ The scale of the maps is about 80 miles to the inch. It shows the Mississippi and Missouri rivers, and some of their tributaries. Nothing in advance of the other maps described was noted, however.

*Thomas Jeffery's American Atlas* was published in London

\* Mr. Oscar Collet, librarian of the Mo. Historical Society, states that there is a copy of this work in the library of the Illinois Hist. Soc. at Springfield, and another in the possession of Mr. H. H. Beckwith of Danville, Ill.

† A careful comparison of this map with the recent charts of the Mississippi River Commission, made by Capt. Palfrey, confirms this statement and shows that the course as delineated by Ross occupies, in some places, the lakes and sloughs of the present alluvial plain.

‡ A copy of this atlas, belonging to Capt. C. F. Palfrey, was inspected by the writer.



in 1775. A reduced copy of portions of his map of North America is contained in Vol. I of the 100th Merid. Reports, opposite p. 512. It contains little detail of interest here. The general course of the Mississippi river adjacent to Missouri is fairly well shown, though the stream is located about 100 miles too far west. The latitudes of the mouths of the Ohio and of the Missouri are approximately correct.

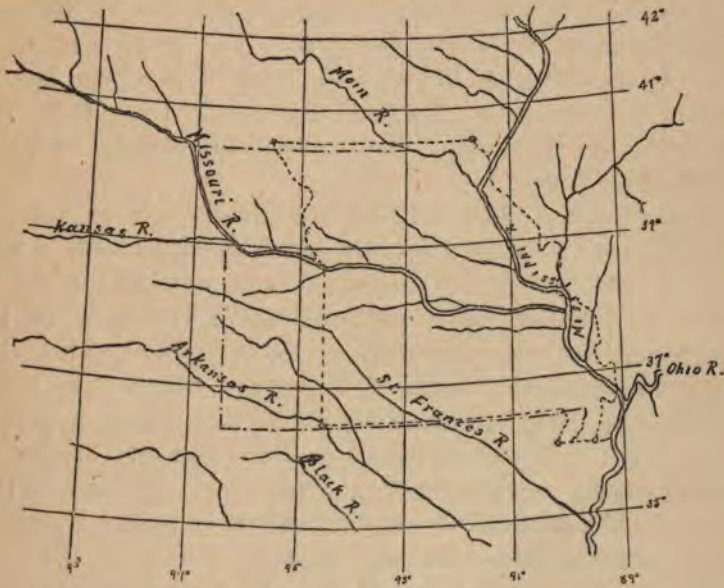


FIG. 9. WINTERBOTHAM'S MAP — 1795.  
Initial Merid., presumably at Greenwich.

In *Winterbotham's History of 1795*, published in New York, is a map of which Lieut. Warren, in the report of the United States Pacific Railway Surveys,\* introduces a reduced copy as exhibiting the knowledge possessed of the territory west of the Mississippi, before the Lewis and Clarke exploration of 1803-1806. A sketch is shown here of a portion of this map relating to Missouri and adjacent country. The courses of the Mississippi and Missouri rivers within the State approximate the locations as known to-day. The longitude of the former stream is at points nearly correct, and in this respect the map is much in advance of the others preceding it.

\* Vol. XI, p. 16.

The mouths of both the Missouri and Ohio rivers are too far south, the former over 30 miles, the latter over 15. The drainage of the southwestern portion of the State is particularly inaccurate, the headwaters of the St. Francois river reaching nearly to the site of Kansas City, and the Arkansas river flowing across the southwestern corner of the State.

*Arrowsmith's map* was published in 1796 and with additions about 1802. It is entitled "A Map of the United States of North America, by A. Arrowsmith." The scale is about 25 miles to the inch. It includes the area of Missouri, but no especially noteworthy features are observed on it.\* The course of the Mississippi river corresponds closely with that of the Ross map.

*In the years 1795 and 1796*, according to a claim recorded in the American State Papers,† James Mackay made a voyage of discovery "to the upper and unknown parts of Missouri," under commission from the Governor of the Provinces, Baron de Carondelet. He is credited with having made a map, as the result of his voyage, which, it is stated, is "such as never appeared before of this unknown part of the world." It was delivered to Don Manuel Gayoso de Lemos, Governor General of the Provinces. No copy of this map was accessible to the writer, and it is doubtful whether one is now extant. Exactly what is meant by the term "Missouri," is not stated. If it relates to the Missouri river this map can probably be put down as the first constructed from actual exploration of that stream.

In works published shortly after this date, maps of this part of the country are frequent. Among these may be noticed the following:—

*Gilbert Imley's map of 1797*, published in his "Topographical Description of the Western Territories." The site of St. Louis is placed on this map at about lat.  $30\frac{1}{2}^{\circ}$  N. and long.  $92^{\circ}$  W. of London.

*L. Colin's map of 1798*, accompanies the "*Voyage à la Louisiane*," etc., in 1794 to 1798, by Baudry des Lozieres.

\* A copy of this map is also the property of Capt. Carl F. Palfrey.

† Public Lands, Vol. VI, p. 718.

The longitude of St. Louis is about  $93^{\circ}$  W. from Paris ( $90\frac{2}{3}^{\circ}$  W. from Greenwich).

The Duvallon map of 1802, is in the "*Vue de la Colonie Espagnole du Mississipi*," etc., 1802, B. Duvallon, editor and author. The longitude of St. Louis is placed at  $74\frac{1}{2}^{\circ}$  W. of *Isle de Fer* ( $92\frac{1}{2}^{\circ}$  W. of Greenwich).

The Lewis and Clarke expedition from St. Louis to the Pacific coast was conducted during the years 1804 to 1807. This may be considered the first definitely recorded survey of the Missouri river. The expedition started at St. Louis and proceeded up the Missouri river in keel boats. The explorers were provided with compasses, chronometers, sextants and artificial horizons.

Various editions of the resultant reports were published. Three of these have been consulted by the writer. The first was issued in London in 1809, under this title: "The Travels of Capts. Lewis and Clarke from St. Louis by way of the Missouri and Columbia Rivers to the Pacific Ocean performed in the years 1804, 1805 & 1806 by order of the Government of the United States containing," etc. "Compiled from various Authentic Sources and Original Documents," etc. — "Illustrated with a map of the country in-



FIG. 10. LEWIS AND CLARKE MAP — 1804 TO 1806.

Edition of 1809.

Initial Merid., at Greenwich.

habited by the Western Tribes of Indians. London. Printed for Longman, Hurst, Rees and Orme, Paternoster Row — 1809." A reproduction of the map accompanying this edition is inserted on p. 75. In the report the Missouri river is said to be about five leagues above St. Louis, at latitude about  $40^{\circ}$  N. The position thus assigned the river does not agree with that shown on the map, as a casual inspection will show, nor is it in accordance with the position of cited in later editions. The map is, however, a very crude production. The mouth of what is termed the "Cansas river" is placed at about  $98^{\circ} 30'$  W., whereas it should be  $94^{\circ} 30'$  W., and it is further located about 450 miles west of St. Louis, whereas it is actually only about 240 miles west. This and other features of the map lead one to believe that it was hastily prepared and does not really incorporate the results of the expedition.

In an edition entitled "History of the Expedition under the command of Captains Lewis and Clarke to the Sources of the Missouri," etc., prepared for the press by Paul Allen, Esq., Philadelphia, 1814," the location of the mouth of the Wood river, opposite the mouth of the Missouri river, is given, on p. 3, as  $38^{\circ} 55' 19\frac{6}{10}"$  N. lat. and  $89^{\circ} 57' 45"$  west of Greenwich, which is about ten miles east of its true position and about five miles north.

The third edition is entitled: "Travels to the Source of the Missouri river and Across the American Continent to the Pacific Ocean, performed by Order of the Government of the United States in the years 1804, 1805 and 1806. By Captains Lewis and Clarke, published from the official report and illustrated by a map of the route and other maps. London. Printed for Longman, Hurst, Rees, Orme and Brown, Paternoster Row, 1814."

The latitude and longitude of the Missouri river, as given in this edition, agrees with that of the Allen edition. The map accompanying this volume is a great improvement over that of the earlier report. The course of the Missouri river is quite accurately shown and, according to the report, was laid down from courses and distances taken in the up passage, corrected by frequent observations of latitude and longitude.

The mouth of the Kansas river is only about ten miles too far east. The tributaries Gasconade, Osage, "Two Charaturns," and Grande rivers are located. From the detail shown of the Osage river, the results of the later Pike expedition hereinafter described, are undoubtedly incorporated in this map.\*

*The Pike Expedition* was conducted during the years 1805–1807. The results were published under the title of "Account of Expeditions to the Sources of the Mississippi and through the Western Parts of Louisiana, to the Sources of the Arkansas, Kans., La Platte and Piere Juan rivers, etc., by Maj. Z. M. Pike." This edition was issued in 1810 by Conrad of Philadelphia, accompanied by large maps. Another edition was issued in 1811 by Longman, Hurst, Rees, Orme and Brown of London, accompanied by quite small maps, entitled: "Exploratory Travels through the Western Territories of North America," etc.

The expedition proceeded up the Mississippi river from St. Louis, noting the course of the stream during their progress. Astronomical observations were also taken. On the map accompanying the London edition, the position of the channel of the Mississippi is fairly well shown. The position of the mouth of the Missouri is taken from Captain Lewis's determinations and is the same as that published in the Philadelphia edition of 1814, of the Lewis and Clarke report. The mouth of the Des Moines river is about in the correct position.

In 1806 Maj. Pike returned to St. Louis and conducted an exploration up the Missouri and Osage rivers; the instruments carried were a sextant, chronometer and compasses. From this expedition there resulted what we may term the first map of the Osage river. The sketch on the next page displays the results as expressed in the map accompanying the Philadelphia edition of the report. The remarkable meanders of this stream are shown, though not to a great degree of accuracy. The Mississippi is also fairly well shown, though not so well as on Ross's map of 1775. The drainage of the Ozark region is very imperfectly represented.

\* The report of the Pike expedition was published by the same firm in 1811, and they hence had the accompanying maps at their disposal in preparing this edition of the Lewis and Clarke report.



FIG. 11. PIKE MAP — 1810.  
Initial Merid. at Washington.

The year 1815 brings us to what we may consider the beginning of the Land Office surveys in the State. During October of that year the Fifth Principal Meridian was begun at the mouth of the Arkansas river and was run north to the Missouri, reaching this stream December 27th, 1815.\* Upon this line all of the subdivisions in the State are based. The survey was made with a compass. No record is contained in the copy of the field notes in the Land Office at Jefferson City, of any observations for the variation of the needle, but such must have been made, for the line to have been run with any approach to accuracy.† In the Land Office Instruction for Deputy Surveyors, dated 1856, it is stated that "Base and Meridian Lines in the District were formerly run with a common compass, and in many instances are far from being correct." Burt's solar compass was later adopted whenever practicable. The instructions further specify that, where local attraction exists, other means than the needle must be used. The law did not require the determination of the latitude and longitude of the base lines and principal meridians.

The Land Office surveys were pursued on what is termed the rectangular system, and were continued in the State up to about the year 1850. The surveys in Bates county and those in the northwestern countries of the Platte purchase were among the latest. In the former, work was done during the years 1843 to '44, and, in Atchison county, during the years 1846 and '47. The last contract recorded in the Missouri contracts is for April, 1852, when some small fractions of sections were surveyed along the Iowa line.

This system of surveys, though very imperfect in plan and inaccurately executed, furnished a vast amount of data for the development of cartography in the State, especially such as related to the details of the locations of the rivers and smaller streams. The results of these surveys, it will be seen later, are incorporated in many subsequent maps.

\* The survey was made by P. K. Robbins, under instruction from Wm. Rector, Surveyor of the Territory.

† Mr. J. S. Higgins, of St. Louis, informs the writer that such observations are recorded in the copy of the original field notes preserved in the Land Office at Little Rock.

In the year 1816 what was then known as the Indian boundary line and what became later a portion of the State boundary line was run north from the mouth of the Kansas river to the present Iowa line, and thence east to the Des Moines river. The survey was made by J. C. Sullivan, deputy surveyor, under instructions of William Rector, surveyor of the territories of Illinois and Missouri. According to the original letter of instructions, attached to the field note book, the deputy surveyor was to run a line north "agreeably to the true Meridian, which you will ascertain before you commence your survey. And if the weather should permit you will frequently make observation of the variation of the needle and will regulate your compass according to the results of your several observations." The line was run, in accordance with these instructions, 100 miles north from the mouth of the Kansas river and thence east a distance of 150 miles and 40 chains to the Des Moines river.

In the year 1820 the State of Missouri was admitted to the Union. The boundaries are described in the act of admission as follows: —

"Beginning in the middle of the Mississippi river, on the parallel of thirty-six degrees north latitude; thence west, along that parallel of latitude, to the St. Francois river; thence up and following the course of that river, in the middle of the main channel thereof, to the parallel of latitude thirty-six degrees and thirty minutes; thence west along the same to a point where the said parallel is intersected by a meridian line passing through the middle of the mouth of the Kansas river, where the same empties into the Missouri river; thence from the point aforesaid, north, along the said meridian line, to the intersection of the parallel of latitude which passes through the rapids of the river Des Moines, making the said line to correspond with the Indian boundary line; thence east from the point of intersection last aforesaid, along the said parallel of latitude, to the middle of the channel of the main fork of the said river Des Moines; thence down and along the middle of the main channel of the said river Des Moines, to the mouth of the same, where it empties into the Mississippi river; thence due east to the middle of the main channel of the Mis-

Mississippi river; thence down and following the course of the Mississippi river, in the middle of the main channel thereof, to the place of beginning.”

The boundary line from the mouth of the Kansas river to the northwestern corner, and thence east to the Des Moines river, is the same as the old Indian boundary line above described as surveyed in 1816. This was apparently accepted as a correctly located State line up to the time of the Platte purchase, in 1836. Immediately after this, however, during the summer of 1837, a new survey of this line was made, in accordance with an act of the General Assembly of Missouri. This line was surveyed by Joseph C. Brown. It began at the rapids on the Des Moines river on the old Indian line. The longitude of this point was calculated from Elliott's determinations, at the mouth of the Ohio, and from the measurements of the Land Office survey, and was determined to be  $91^{\circ} 46' 40''$  west of Greenwich. The latitude was determined by astronomical observations to be  $40^{\circ} 44' 6''$  north. Several latitude determinations were made along the line and observations for the variation of the compass were frequently taken; a compass was used in the work, and its bearings were checked by back sights. The total length of the line from the Des Moines to the Missouri river as measured, was 203 miles and 33 chains. The longitude of the N. W. corner was calculated to be  $95^{\circ} 39' 13''$  and the latitude, from observations about  $40^{\circ} 44'$ .

The location of this survey seems, however, not to have been acceptable to the State of Iowa and more or less litigation arose therefrom. Hence in 1850, a new survey was ordered by the Supreme Court of the United States.\* The starting point taken was Sullivan's N. W. corner, established by the Survey of 1816.† The latitude of this point was determined to be  $40^{\circ} 34' 40'' 3$  N.; the longitude calculated from the Land Office maps was determined to be  $94^{\circ} 30'$  W. of Greenwich. The line was run due west on a parallel for a distance of 61 miles and 61 chains to the Missouri river;

\* See Howard's Report, Vol. 10.

† The surveyor for Missouri was R. Walker, and the one for Iowa was Wm. Dewey.

Burt's solar compass was used. The line east followed Sullivan's old line, notwithstanding the fact that the latter was found to be quite crooked and to diverge from the parallel in many places. It was marked by posts every 10 miles. The length of this portion of the line was found to be 150 miles and 51.80 chains, making the total length of the boundary line, from the N. E. to the N. W. corner, 211 miles, 32.80 chains, a result differing about 8 miles from that of the Brown survey of 1837. The line as thus surveyed was adopted.

The survey of the western and southern boundaries of the State from the mouth of the Kansas river to the St. Francois river, was originally begun in September of the year 1823, shortly after Missouri became a State. The surveyor was Joseph C. Brown, acting under the instructions of Genl. Wm. Rector, surveyor of the U. S. lands of Illinois and Missouri. The line was completed December 8, of the same year. According to the original field notes, it started from the mouth of the Kansas river, after observations for the magnetic variation had been made. Thence, it continued south for a distance of 177 miles to a determined latitude of  $36^{\circ} 30'$  north.\* At this point the S. W. corner of the State was marked by a stone post, and the line was continued east to the St. Francois river, under great hardships and difficulties. Determinations of latitude were made at intervals along the W. to E. line and the party was at one place as much as 31" out of position. The line was run with a compass, and a theodolite, sextant and an artificial horizon were part of the equipment. The line between the St. Francois and Mississippi rivers was not run at the time owing to the exhaustion of the party, the equipment and the funds. The distance from the S. W. corner to the St. Francois river was determined to be 232 miles and 28 chains. No latitude determination was made at the St. Francois river.

The survey was continued by Brown the following year, in October, 1824. According to the field notes the latitude of

\* Later calculations with the aid of the Nautical almanac led Mr. Brown to place this point at  $36^{\circ} 30' 4''$ .

A resurvey of the portion of this line between the 26 mile post and the Marais des Cygnes river on the 62 mile, was made in November, 1844.

the point reached at the end of the past years work was  $36^{\circ} 30' 11''$ . Thence the course of the St. Francois river was meandered out down to a determined latitude of  $36^{\circ}$  N. Thence a line was run due east to the Mississippi river.

The Brown survey, probably on account of the acknowledged inaccuracies and for other reasons, was not acceptable and, hence, we find, in the year 1843, a new survey of the southern boundary of the State begun under the direction of a joint commission from Missouri and Arkansas, in accordance with acts of the respective legislatures. The survey was begun on the Mississippi river on the latitude  $36^{\circ}$  N. which was determined with a sextant and an artificial horizon. The line was run thence west to the St. Francois river, a distance of 36 miles and 50 chains. It was found throughout its whole length, to be about 600 yards N. of the line determined by the Brown survey. Thence, they proceeded north to a point on the St. Francois river which they determined to be at  $36^{\circ} 30' 11''$  N. and about one chain north of the old Brown line. The line thence ran W. soon crossed the Brown line and kept south of it the remainder of the distance. At no other point, however, was it so much as a half a mile south. It terminated 4.83 chains due south of the southwestern corner of the State, as marked by Brown in 1823. This last survey made the south line of the State about ten miles longer than did the earlier one and this latter result accorded with the Land Office surveys. This appears to be a carefully conducted survey and a neatly drawn map of the line accompanies the copy of the original notes in the Land Office at Jefferson City. The line as marked by this survey was accepted as the south boundary of the State and is still recognized as such.

Returning from this digressive sketch of the history of the State boundary surveys we will take up again the chronologic notice of explorations and maps of our area.

*Rector's and Roberdeau's map*, was compiled in the year 1818. It is entitled "Sketch of the Western part of the Continent of North America, between latitudes  $35^{\circ}$  and  $52^{\circ}$  N." It extends from the 87th Meridian to the Pacific ocean, and is on a scale of about 47 miles to the inch. It was originally drawn by Roberdeau of the U. S. Topographic

Engineers under the direction of Wm. Rector, Surveyor of the U. S. for the territories of Missouri and Illinois, and was presented by the latter to the General Land Office. It was presented as probably the most correct map of the country extant at that time.\* In it are presumably incorporated the results of the meridian and boundary surveys which had been made in Missouri prior to that date. The Mississippi river s, however, placed from 60 to 100 miles east of its true position, and the mouth of the Kansas river is fully 30 miles too far east. St. Louis and the Missouri river are some 80 miles south of where they should be. These results indicate that the observations of the preceding Lewis and Clarke and Pike expeditions were not made use of.

*The Long Expedition* was conducted during the years 1819 and 1820. The results are published under the title of "Account of an Expedition from Pittsburg to the Rocky Mountains," etc., "compiled by Edwin James, botanist and geologist for the expedition, In two volumes with an atlas." Philada: H. C. Carey and I. Lea, 1823. The party proceeded down the Ohio river to its mouth, and thence up the Mississippi and Missouri rivers. They were provided with chronometers, sextants, compasses and a telescope. Their results are embodied in a map accompanying the report, on a scale of about 75 miles to the inch. A portion is shown on the sketch on page 85, which is from a tracing of the map. Eliot's determinations of 1797-98, at the mouth of the Ohio are quoted and are referred to in later determinations. These are:

Lat.  $37^{\circ} 0' 22.9''$  N.

Long.  $88^{\circ} 50' 42''$  W. of Greenwich.

Proceeding up the Mississippi river the position of Cape Girardeau was determined.

From three observations—  $37^{\circ} 18' 39''$  N. Lat.

{ From traverse measurements  
{ from the mouth of the Ohio  $89^{\circ} 17'$  W. Long.

The mouth of the "Merameg" river was determined to be at  $39^{\circ} 23' 29''$  N. Lat.

\* A reduced copy of this map is published opposite p. 23 of Vol. XI, of the reports of the Pacific R. R. Surveys.

The location of St. Louis was variously established as follows:—

Lat. (mean of three observations),	38° 36' 18" N.
Long. " " " "	90° 6' 15" W.
" (from traverse measurements from mouth of Ohio),	90° 2' 35" W.

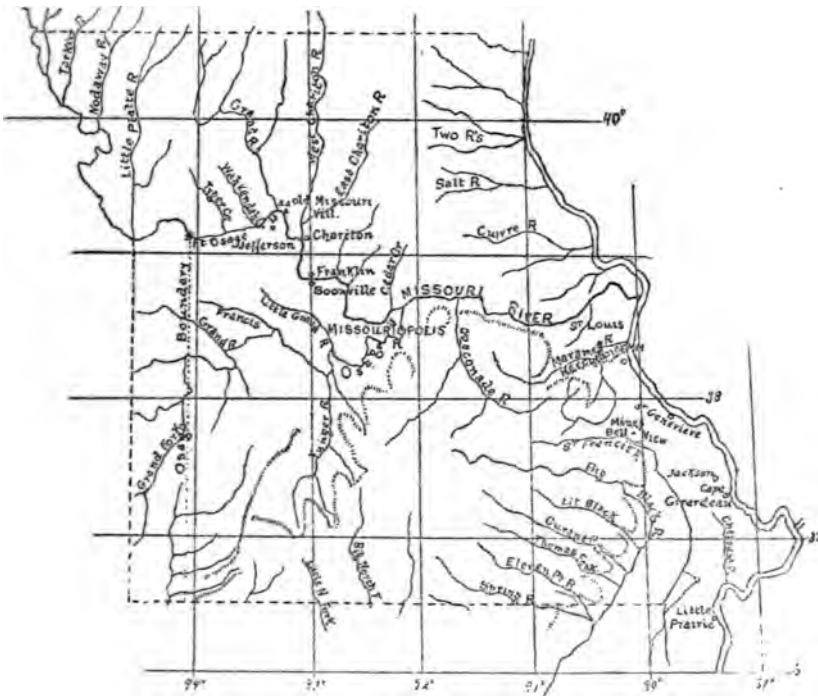


FIG. 12. LONG MAP — 1820.  
Initial Merid. at Greenwich.

The mouth of the Missouri river was similarly determined to be at:

Lat. (mean of four determinations),	38° 51' 39" W.
Long. (from lunar observations),	89° 57' W.
Long. (from traverse measurements),	90° 00' 40" W.

These first two results accord quite closely with Capt. Lewis's earlier observations.

The following determinations were further made, up the Missouri river: —

Franklin, Howard Co.

Lat. (mean of three determinations),  $38^{\circ} 57' 09''$  N.

Long. (mean of three determinations),  $92^{\circ} 57' 05''$  W.

Fort Osage.

Lat. (mean of three determinations),  $39^{\circ} 09' 33\frac{1}{2}''$  N.

The State line is introduced in the original map in the position shown on the accompanying sketch; also the old Osage boundary line. The true drainage of the Ozark region is faintly suggested, though the peculiar system of tributaries of Black river is wholly imaginary.

*Finley's map of North America* was published in 1826, under the title of "Map of North America, including all the recent geographical discoveries." A reduced copy is included opposite p. 30 of Vol. XI., of the Pacific railway reports. The portion embracing Missouri shows nothing in advance of the earlier Long map, and is probably largely copied from that map. The Ozark mountains are outlined in a general way, but the drainage system of that area is very inaccurate.

In 1825 a survey of a road from Fort Osage to Taos in New Mexico was begun by order of the U. S. Government, by J. C. Brown. Fort Osage was the starting point, which was taken at  $93^{\circ} 51' 03''$ .\*

In 1837 there appeared a map on a scale of 50 miles to the inch, compiled by the United States Topographical Bureau, entitled "A map illustrating the plan of the defenses of the western and northwestern frontier." It was compiled under the direction of Col. J. J. Abert, and is published in Senate Document No. 65 second session, 25th Congress. The representation of Missouri is much in advance of that of any previously published. The Mississippi river is placed about 10 miles west of its true position, but the latitudes of points along it, in, and adjacent to the State, are fairly correct. The drainage displayed of the interior bears, in a general way, a close resemblance to that of our modern maps; especially of the Ozark region is the representation of the drainage an ad-

\* See Pacific R. R. Reports, Vol. XI, p. 25.

vance over earlier maps. From the results of the Land Office surveys many such details were doubtless incorporated.

Between the years 1836 and 1840, certain surveys were conducted and observations were made by I. N. Nicollet, for the government along the Mississippi and Missouri rivers. The results are contained in Senate Document No. 237, 26th Congress, second Session; a map accompanies this embracing the territory between  $38^{\circ}$  and  $40^{\circ} 30'$  of Lat. and between  $89^{\circ}$  and  $101^{\circ}$  of Long. He is credited with having made the first use of the barometer in connection with such work in the west. The longitude of St. Louis cathedral was determined to be  $90^{\circ} 15' 10''$ , and that of Fort Leavenworth  $94^{\circ} 44'.$ \*

A fair summary of the existing knowledge of geographic locations about the middle of this century, is contained in a table in "French's Historical Collections of Louisiana" (1846-53) in which, along with many others beyond the limits of Missouri, the following locations are given. They are derived from determinations of Long, Nicollet and others.†

	Distance from Gulf. Miles.	Altitude of surface of water above Gulf. Feet.	North latitude.	Longitude West of Greenwich.
New Madrid.....	1115	.....	$36^{\circ} 34' 30''$	$89^{\circ} 17' 15''$
Cape Girardeau.....	1257	.....	$37^{\circ} 18' 39''$	$89^{\circ} 17' 0''$
St. Genevieve, church.....	1330	372	$37^{\circ} 59' 47''$	$90^{\circ} 11' 10''$
St. Louis, cathedral garden.....	1390	382	$38^{\circ} 37' 28''$	$90^{\circ} 15' 39''$
Missouri, mouth of, south bank.....	1408	388	$38^{\circ} 50' 50''$	$90^{\circ} 13' 45''$
Gasconade river, mouth of.....	1513	.....	$38^{\circ} 41' 40''$	.....
Portland, Callaway county.....	1523	.....	$38^{\circ} 42' 57''$	$91^{\circ} 40' 15''$
Osage river, mouth of.....	1543	.....	$38^{\circ} 35' 0''$	.....
Boonville .....	1604	530	$38^{\circ} 57' 18''$	$92^{\circ} 41' 30''$
Grand river, S. W. of mouth.....	1670	.....	$39^{\circ} 19' 0''$	.....
Old Fort Osage, right bank.....	1748	.....	$39^{\circ} 9' 33''$	.....
Kansas river, mouth of.....	1790	.....	$39^{\circ} 5' 25''$	.....
Fort Leavenworth .....	1820	746	$39^{\circ} 22' 40''$	$94^{\circ} 44' 0''$

\* According to the measurements of the Land Office surveys the longitude of Fort Leavenworth is  $94^{\circ} 58'$ , while the most recent results make the longitude of the observatory of Washington University, St. Louis,  $90^{\circ} 12' 30''$ . Similarly the longitude of Fort Osage as determined by J. C. Brown in 1826 was  $93^{\circ} 51'$ , while the Land Office measurements make it  $94^{\circ} 15'$ ; the longitude of Westport was determined by Fremont in 1843 to be  $94^{\circ} 22'$ , and by Land Office measurements it is  $94^{\circ} 37'$ .

† Historical Collections of Louisiana. By B. F. French. Vol. II, p. 298. New York: Wiley & Putnam, 1846-53.

In the year 1858 was published the map compiled by Lieut. G. K. Warren to accompany the reports of the Pacific railway surveys. It is contained in Vol. XI of the series of reports. In preparing this map Lieut. Warren studied carefully many of the previously published maps which have been described here, and he utilized the various astronomical determinations of the earlier exploration, though in a discriminating way; he also had available the Land Office records and to these were added the data obtained by the newly executed surveys of the various practicable railway routes to the Pacific ocean. The result was, consequently, a map much in advance of anything so far published, both as to accuracy of location and amount of detail included. A copy of a tracing of this map is presented here, and a brief inspection will suffice to show that, for the scale used, a much better outline map of the State could hardly be prepared from our best maps of to-day.



FIG. 13. WARREN MAP — 1857.  
Initial Merid. at Greenwich.

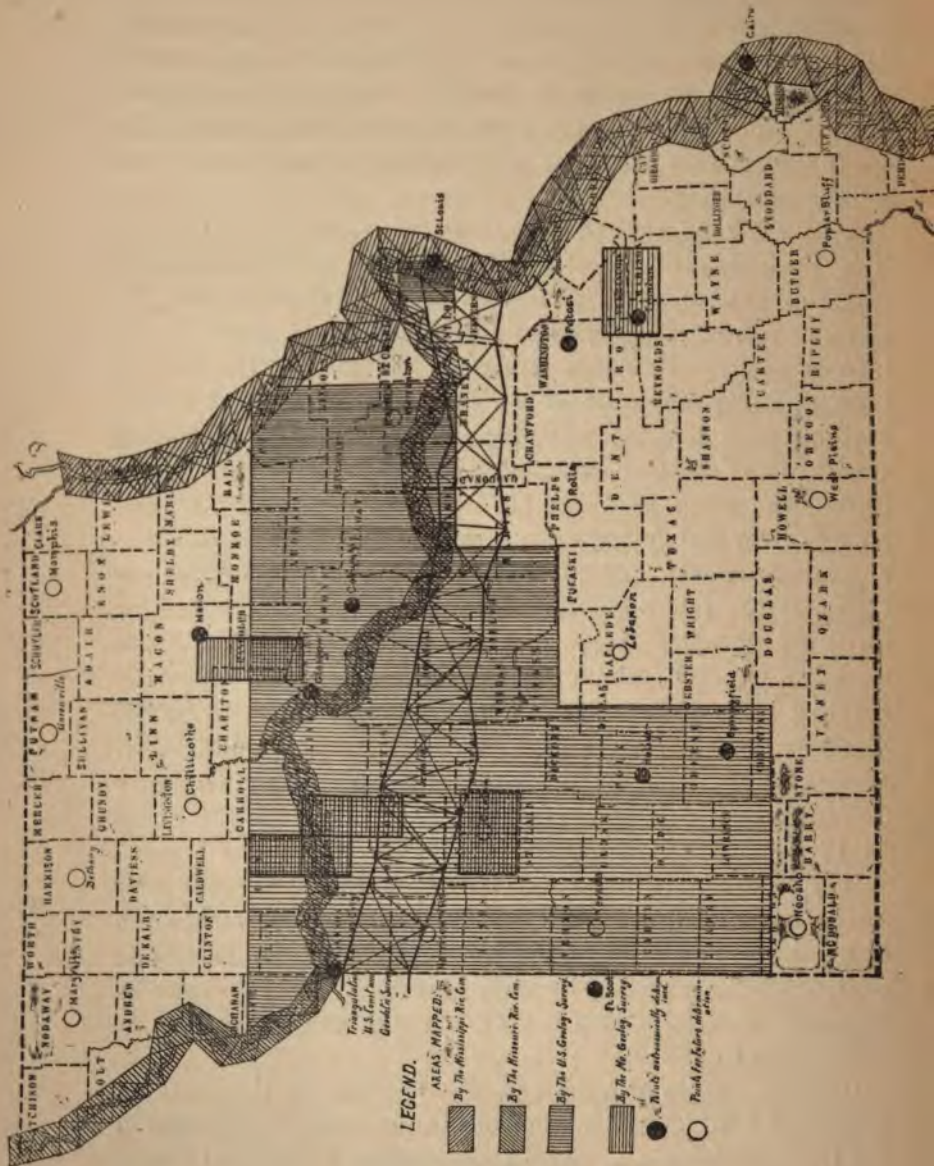
With the Warren map and the results of the Pacific railway

surveys, we reach the end of what we may term the period of explorations, when the work was of the nature of a reconnoissance, when determinations were confessedly of only very approximate nature and little or no detail was attempted. During the next decade the war and the succeeding years of reorganization prevented any further progress of geographic work. Not until after the year 1870 was such resumed and we then pass into what may be called the period of exact and detailed mapping.

*The work of the U. S. Coast & Geodetic Survey.*—The beginning of precise and detailed geographic work was the extension of the trans-continental chain of triangles by the U. S. Coast and Geodetic Survey from Illinois into Missouri. This was started in the year 1871, when a base line was measured in the Missouri bottoms and several stations were selected. During the year 1873 triangulating was resumed and was extended 32 miles west of St. Louis; during the years 1874 and 1875 it was extended to the Gasconade river and during the years 1879 to 1886 the work was continued uninterruptedly and the triangles were carried entirely across the State into Kansas. The position of this chain of triangles in the State is clearly shown in the diagram on page 90. Following this belt of triangles, precise-leveling has now also been completed across the State by the Coast and Geodetic Survey. This work was carried from St. Louis to New Haven in the year 1882; from New Haven to Jefferson City in 1888 and from Jefferson City to Kansas City in 1891.

*The Mississippi River Commission* was organized in the year 1879. At this date only about 18 miles of the river from Cairo down, had been mapped. Since that time, according to data kindly furnished by Capt. Carl F. Palfrey, the present secretary of the Commission, their operations have been as follows, up to 1891:—

“Under the appropriations of 1881–82, in the working seasons of 1881–2–3, this work was carried southwards beyond the limits of Missouri. Also triangulation was carried northwards to Keokuk, Iowa, covering the Missouri front. Under the appropriation of August 11th, 1888, in what remained of



the season of 1888 and in that of 1889, topographical work was completed from Cairo to Alton, Ill. The section of precise levels from Illinois river to Cairo was run in 1880; that northward from Illinois river in 1883. Even if there should be no appropriation at this session of Congress, the topography will reach the northern boundary of Missouri during the working season of this year. The reduction and publication of maps has followed the same course as the field work. Ten sheets, scale 1:20000, from Cairo to the southern boundary of Missouri were published in 1888-89; 14 sheets, from Cairo to Carondelet, have been published in 1890-91. Unless there is an appropriation at this session it is not probable that publication can be continued at present."

The area mapped by the Commission is shown on the diagram opposite page.

The published maps of the Mississippi river Commission are on two scales. One series consists of large sheets 22 inches by 36 inches, on a scale of about 31 inches to the mile. These show all detail of importance to the navigator, such as the shore line, the positions of bars, and the depths of the water; the topography on each side of the alluvial plain is shown in five foot contours, timbered and open country are distinguished and many other recognizable land marks are introduced. The second series of maps are not much more than reductions of the larger maps and include less detail. They are issued on a scale of one mile to the inch, in sheets 12 by 22 inches.

*The work of the Missouri River Commission* was begun in 1878. Their mapping is similar to that of the Mississippi river Commission and in the words of their reports, embraces "an accurate delineation of the shore line, islands and sand bars," the general topographical features of the valley and the line of bluff bordering the same, the whole checked by a system of triangulation carried along the river banks." Soundings were also made along lines normal to the current and from 500 to 1500 feet apart. The survey commenced in 1878 at the town of Weston and was extended thence to Boonville during that year; a line of unchecked levels was carried along with it. During 1879 the survey and line of unchecked

levels was continued to St. Louis. In 1880 a line of carefully checked levels was run from Sioux city, Iowa, to the mouth. During the succeeding years, up to October 1884, no further surveying was done, but, during the fall of that year, the Commission determined upon a secondary triangulation of the river from bluff to bluff and also determined to establish lines of permanent bench marks, the whole to be connected with the former survey. This work was commenced October 12th at Glasgow and reached Boonville December 15th; the work was continued all of the winter and was closed with the Coast Survey triangulation station at Tavern Rock the following May. In 1889 triangulation was extended above Fort Leavenworth. In the autumn of 1890 a new shore line survey was made of the whole of that portion of the river, within the State. One series of maps is published containing the results of this work, on a scale of one mile to the inch. The area covered by these sheets is also indicated on the diagram on page 90. They contain less detail than do the larger sheets of the Mississippi river survey.

*The United States Geological Survey* has undertaken, as part of its work, the preparation of a topographical atlas of the country. For this purpose, along with work prosecuted elsewhere, maps have been constructed of about one-third of the area of this State. The distribution of this mapping is clearly shown in the diagram on page 90. The survey was begun in the year 1884 and was continued uninterruptedly up to July of 1889. Since that time no further work has been done. The product up to the present date is 25 sheets in Missouri and five sheets including portions of Missouri and Kansas, all on a scale of  $\frac{1}{125000}$ , or about 2 miles to the inch, with a contour interval of 50 ft.; also two sheets, including St. Louis and parts of St. Louis county, and Illinois, on a scale of  $\frac{1}{62500}$ , or about one mile to the inch, with a contour interval of 20 ft. All of these sheets are of uniform size,  $16\frac{1}{2}$  by 20 inches, and the area represented on each is a geographic one and is a fraction of a square degree of latitude and longitude. These maps have represented upon them the drainage in blue; the hypsometry in brown; the cultural features, such as towns, railroads, roads, political and

cadastral division lines in black. They constitute the first series of maps which even attempts to display, in a comprehensive and systematic way, the topography of the State, or of any large part of it. They are much in advance of anything previously published. The principal objections which can be urged against them are that the scale is too small and the contour interval too great for the characteristics of much of the topography of the State to be well brought out or for many valuable details to be closely located or even included. Further the method of work employed furnished a weak vertical control and the altitudes represented are, hence, very inaccurate in places. A fifty foot contour and a scale of two miles to the inch though calculated to well display the general features of a mountainous country of large and bold features, fails to be adequate in a prairie country where differences of elevation of twenty feet are significant and conspicuous.

The method of construction of these maps is described in the following words by Mr. Henry Gannett, Chief Topographer of the United States Geological Survey, in a letter to the writer: —

“The primary horizontal control consists of the triangulation of the Coast and Geodetic Survey and of the Missouri River Commission, supplemented where these surveys have not extended, by astronomic determination.\* The secondary horizontal control consists in part of the location made by the U. S. Land Surveys (their township and section corners) this system having been connected with the primary locations for the purpose of eliminating their accumulated errors; and in part of traverses of roads and other routes of travel. In these traverses the directions were measured by compass and distances by the wheel. The primary measurements of height were obtained from levels along the Missouri river and the profiles of railroads, secondary height measurements were made by the cistern and aneroid barometers, the latter being corrected by comparison with cistern barometer and by comparison with the known heights of points upon railroads.

\* Points were established at Springfield and Bolivar, Mo., and at points adjacent to the State line in Kansas. A. W.

The sketching was done in approximate contours upon sketching boards directly from the country as copy.\*

"I have not at hand the figures of cost attendant upon this work heretofore, but from experience in similar regions in recent years, I should place the expense of the work in the northern prairie portion of the State, including all expenses connected with it, at about two dollars a square mile. In the broken and heavily timbered southern portion of the State I would say that a satisfactory map could be made for between three and four dollars per square mile, and here the cost would depend greatly upon the character of the men engaged upon it, for it is a very difficult piece of country to survey.† The above figures imply of course that the map is to be made for publication upon the scale of  $\frac{1}{125000}$ . Increase of scale would increase the expense incident to the survey considerably." ‡

A serious defect in these maps for many every-day uses is the omission of the township range and section lines. The political division lines are shown, but these are much less permanent and of less general use than are the omitted cadastral lines.

*The Missouri Geological Survey* has had an intermittent existence since the year 1853. The first survey, under Prof. G. C. Swallow, was in operation from that year until June, 1861; the second survey, under Messrs. A. D. Hager, Raphael Pumpelly and G. C. Broadhead successively, continued from the year 1870 until 1875; the third survey, under Mr. Arthur Winslow, began in the autumn of the year 1889 and is still in

\* Since this work was commenced, in 1884, the improvements of instruments and methods have been such that in similar country there will be considerable differences in the methods employed at present, for instance the cistern barometers would not be employed but in place thereof lines of dip angles would be run at intervals for the purpose of checking the indications of the aneroids which would be employed in the measurement of minor heights. The plane table provided with a compass for orienting would be employed in traversing.

† These estimates do not include the cost of engraving and printing. A. W.

‡ Similar maps on a scale of 1:62,500 constructed by the U. S. Geological Survey of Massachusetts, Rhode Island and Connecticut, cost in the vicinity of \$10.00 per square mile. A. W.

progress. The work of the First and Second Geological Surveys included little original work in the line of geographic mapping. Accompanying the county reports of these surveys, there are small maps published on scales of three and four miles to the inch of some thirty counties. These maps contain, in addition to the geological matter, such facts of geography and topography as could be obtained from the Land Office plats and from published maps, supplemented by observations made in the field while prosecuting geologic work. The counties are printed on separate sheets on which the township range and section lines are shown, and the towns, railways and drainage; at times prominent elevations are indicated by hachure lines, but this only at intervals. The amount of detail shown on the different sheets is quite variable. In addition to these county maps, there were published under the Pumpelly management, as a result of original work, a topographic map of Pilot Knob and vicinity on a scale of about 1200 feet to the inch, and, under the Broadhead management, a contoured map of the Granby mining district on a scale of 300 feet to the inch.

The Third Geological Survey, now in progress, has undertaken, as part of its work, the preparation of detailed maps of different portions of the State. These maps include the details of the topography as well as those of the geology proper. The scale adopted is  $\frac{1}{62500}$  or about one mile to the inch. The area represented by each sheet is a quadrilateral of 15" extent in latitude and longitude; this may be, within the State, anywhere between 228 and 240 square miles. The size of the sheet, including the margin, is  $16\frac{3}{4}$  by  $20\frac{3}{4}$  inches. This work has been prosecuted during the field seasons of the years 1890 and 1891, and, as a result, there have been surveyed and plotted up to date ten sheets, distributed as shown on the diagram opposite p. 91. During the present field season three or four more will be surveyed.

The map attached at the end of this paper is a printed copy of one of these sheets, from engravings on stone. As is there shown the drainage, the hypsometry and the cultural features are represented respectively in blue, brown and black, as on the sheets of the U. S. Geological Survey. The scale is, how-

ever, twice as great, the contour interval is 20 ft. instead of 50 ft., the township and section lines are added and the distribution of the formations and other geological facts are shown.\* The adoption of the larger scale permits the representation of much valuable detail which is omitted from the U. S. Geological Survey sheets and the methods used insure much greater accuracy in the determination of both horizontal position and altitude.

The methods by which these maps are constructed are somewhat different from those used by the U. S. Geological Survey. They are the outgrowth of work prosecuted under the writer's direction during the past four years; they are the most satisfactory, to his knowledge, for accomplishing all the ends in view, both with regard to cost as well as quality of product. The geographic co-ordinates of the sheet have first to be determined. For this purpose the results of the triangulation of the U. S. Coast and Geodetic Survey, and of the Mississippi and Missouri River Commissions are used where applicable; elsewhere astronomical determinations have been made. These results furnished the primary horizontal control, and subject to such control, the township and range lines are located on the sheet. Within each cadastral township, so outlined, the section lines were located from the Land Office sheets, discrepancies within such townships being distributed. The railway lines were plotted from the maps of the respective roads and these, together with the section and other land division lines, served as lines of horizontal control. The drainage has been plotted, in part, from the Land Office sheets, at least the points of intersection of streams and section lines have been generally obtained in this way. Such locations are, however, checked by frequent intersections with the meander lines of the topographic work. Vertical control for contouring is obtained primarily from the precise leveling of the Coast and Geodetic Survey and of the River Commissions and, secondarily, from the profiles of the various railways. In addition to these, lines of level are run by the Geological Survey through each township, which furnish frequent bench marks and, in addition, fix with exactness the relative eleva-

\* A section sheet accompanies this map, as issued by the Geological Survey, showing the structure of the area and details of the stratigraphy.

tions of coal beds and topographic features of special importance. Between these lines, altitudes have been determined by aneroid barometer measurements along the lines of meander surveys. Such meander work was performed with hand compass and paced distances following along roads, or along section or other land lines, and, in all cases, was checked by frequent intersections with such lines. In such surveys the topography was sketched, at the same time, directly into the note book and all observed geological occurrences were located in their proper topographic positions. These methods are accepted as adequate for the construction of a topographic map for purposes in view, on the scale and with contour interval used. More must not, however, be *demand*ed of such maps, than these considerations warrant, though they will prove of value in the future for many other industrial and scientific uses than those for which they were especially constructed. They portray with exactness the distribution of upland and lowland with reasonable faithfulness the relative elevations of the various hills. It is not maintained that the exact amount of grading necessary for the construction of a railway across the areas represented can be calculated from the study of these maps; yet, on the other hand the general question of the practicability of construction along any line can be determined at a glance.

The plan of publication proposed for these sheets contemplates that they shall be issued under paper covers, together with the accompanying section sheet, unfolded at the end of a folio report of a dozen or more pages of the same size as the map. A series of these sheet reports can be bound later under more substantial board covers. The areas selected for such detailed work, are those which are of prominent economic importance, or which are of great geologic and scientific interest. It is the intention to complete several such sheets each year, along with the other work of the survey of more general nature. The value of such detailed work to the State is second to none among the various products of the Survey's operations and we feel little hesitation in predicting that this series of maps and accompanying sections and reports will prove of more substantial and enduring value than any other of the publications.


The cost and the quality of this mapping depend very greatly upon the character and talent of the men executing it. The work demands a sound constitution, industry and perseverance, attention to details and, above all, an eye for topography. The sluggard has no liking for the work, the slurrer should have no place in it. This work of the Survey so far, is distributed over prairie and timber country, in flat and in hilly portions of the State. The results have been reached at the extremely low cost of not more than \$2.00 per square mile. This includes the cost not merely of the topographic work, but also of incidental geological work, as well as the reduction of notes and the plotting of maps and sections. The cost of engraving and printing is, of course, not included, nor is the cost of triangulation, of astronomical work, or of administration. The figure given covers merely the salaries and expenses of the parties doing the work in field and office. It is believed that the work can be extended into any portion of the State at an average cost of little more than this amount and an allowance of \$3.00 per square mile is certainly most ample.

As a necessary preliminary to the detailed mapping in the State the latitudes and longitudes of a number of points have been determined. These were made in part by the U. S. Geological Survey and in part by the U. S. Coast and Geodetic Survey, both being assisted by Prof. H. S. Pritchett of the Washington University Observatory. The points thus far determined as indicated on the map are:—

	<i>Lat.</i>	<i>Long.</i>
SPRINGFIELD, GREEN COUNTY (U. S. G. S.)		
Pier, in Drury College grounds	37° 13' 15.96"	93° 17' 17.58"
BOLIVAR, POLK COUNTY (U. S. G. S.)		
Pier, in S. W. Baptist College grounds	37° 36' 35.22"	93° 24' 47.68"
ST. LOUIS (Pritchett)		
Pier, Observatory Washington University	38° 38' 3.6"	90° 12' 30"
IRONTON, IRON COUNTY (U. S. C. & G. S. & Mo. G. S.)		
Pier, just east of depot	37° 36' 30.76"	90° 37' 36.68"
POTOSI, WASHINGTON COUNTY (U. S. C. & G. S. & Mo. G. S.)		
Pier, Court House yard	37° 56' 14.62"	90° 47' 16.16"
MACON CITY, MACON COUNTY (U. S. C. & G. S. & Mo. G. S.)		
Pier, Court House yard	39° 44' 32.9"	92° 28' 14.2"
COLUMBIA, BOONE COUNTY (Pritchett)		
Observatory State University	38° 56' 51.6"	92° 19' 34.05"
GLASGOW, HOWARD COUNTY (Pritchett)		
Observatory College	39° 13' 45.6"	92° 49' 29.55"

Reference to surveys and original maps in the State, would not be complete were mention omitted of all the various railway surveys and the resultant maps. These have furnished a great amount of data and, were all the results of such surveys available we should have material for the construction of topographic maps of considerable portions of the State. As it is their locations of constructed lines are valuable base lines for all operations of geographic surveying and their profiles are invaluable for determinations of altitude.

Innumerable maps have been constructed of the State of which no mention has been made here. The reason for this is that these maps are compiled and are not prepared from new and original surveys. All of what is entitled to the name of original geographic work, in an extended sense, is referred to here. Many excellent and serviceable maps have been compiled from the Land Office plats, supplemented by railway maps. Many county atlases have been similarly prepared. To these, county roads, post-offices, school-houses, churches, boundaries and other such features are added from county records and from observations on the ground.



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